THE PLANT DISEASE REPORTER

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Division of Mycology and Disease Survey

BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

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IN THIS ISSUE

Q. L. Holdeman and T. W. Graham discuss the effects of various plants on the maintenance and increase of sting nematode populations, page 497.

C. E. Yarwood describes a quick rubbing method for inoculation with viruses, page 501.

Results of transmission trials with crinkle-scurf of citrus in Florida indicate that the trouble is a bud-propagated somatic mutation, according to L. C. Knorr, page 503.

Paul D. Keener reports the presence of western X-disease of peach in Arizona, page 508.

Incidence of peach scab was markedly reduced on whitewashed trees, in Georgia experiments reported by Glenn KenKnight and Julian F. Jones, page 509.

Some diseases that are important in southeastern peach orchards when control measures are not used are reported by John R. Cole, page 510.

Richard H. Converse reports two fungi recently found on pecan in Oklahoma, for the first time in the State, page 511.

O. T. Page describes a Botrytis leaf spot of onion leaves that was prevalent in an Ontario location during the past two seasons, page 513.

Results of cross-inoculations and pathogenicity tests with New Jersey isolates of Sclerotinia sclerotiorum, S. minor, and S. trifoliorum are reported by Victor M. Held and C. M. Haenseler, page 515.

A technique for field inoculation of red clover with Sclerotinia trifoliorum is described by J. H. Graham and R. G. Hanson, page 518.

Diseases attacking the forage legume big trefoil in Georgia are reported by Homer D. Wells, page 521.

W. E. Sackston reports foot and root infection by safflower rust in Manitoba, page 522.

J. G. Brown and Thomas G. Scandone report an apparently new bacterial parasite of tamarisk or "salt-cedar" in the Southwest, page 524; indications are that it is the cause of widespread dying of this objectionable weed plant.

Kenneth F. Baker and others describe a grafting failure of ornamental plants caused by Thielaviopsis basicola, page 526.

Unusual records and other brief notes, page 527: pathogenicity of the oak wilt fungus to Quercus chrysolepis and Q. agrifolia, by Paul F. Hoffman; additional hosts of the tomato buckeye rot fungus observed in Tennessee, by E. L. Felix; incidence of some tomato diseases in Tennessee this year, by E. L. Felix; powdery mildew on tobacco in Kentucky, by R. A. Chapman; peanut rust in Georgia, by Harvey W. Rankin.

August weather, page 529.

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THE EFFECT OF DIFFERENT PLANT SPECIES ON THE POPULATION TRENDS OF THE STING NEMATODE

Q. L. Holdeman and T. W. Graham

The importance of the sting nematode, Belonolaimus gracilis, Steiner (1949) as a serious root parasite of crop plants has been pointed out by workers in Florida (1, 3, 4, 5, 12), Virginia (2, 10, 11), and South Carolina (7, 8, 9). Beans, celery, corn, cotton, cowpea, lima bean, millet, onion, pea, peanut, pepper, soybean, squash, and strawberries are listed as crops that may be injured. It has also been pointed out that cabbage, cauliflower, endive, and lettuce do not seem to be seriously affected (5).

While the above reports include observations on field damage and of pathological effects on the hosts, little information is available on the relative susceptibility of different crops or the results of a systematic study of the host range. Such studies are of obvious value to the development of crop rotations for control, or as a source of information for further experimental study. Therefore, the studies reported here were started with the following objectives: (a) to confirm field observations, (b) to determine relative population increase of the sting nematode on various hosts, (c) to find crops that might serve as "carry over" hosts, and (d) to find crops that reduce or eliminate sting nematodes in infested soil.

Materials and Methods

During 1951 and 1952, collections were made of soil naturally infested with sting nematodes from different farms. Each lot of soil was brought to the greenhouse, mixed thoroughly, and the initial nematode population determined. The soil collections were potted in 6-inch pots which hold approximately 1500 cc of soil. Seeds or plants were planted in triplicate pots for each host studied. Pots were then transferred to a greenhouse bench. In each test, a known susceptible host was planted in the infested soil for parallel comparison with each host under test.

After two or two and one-half months, each pot was sampled and the nematodes were counted by a standardized technique. The soil from each pot was emptied on paper and mixed thoroughly. A 300 cc sample was drawn by taking small pinches of soil from various locations throughout the pile. Nematodes were freed from the sample by Christie and Perry's technique (6) and were collected in a 90 mm. petri dish. Approximately 5 percent of the dish area was observed by using a stereoscopic microscope with 72X magnification and selecting 80 fields at random. The actual number of sting nematodes observed was designated as the population index (PI).

Results

The average PI for each host tested is recorded in Table 1, along with the highest and the lowest indices observed in individual pots.

In the legume group, high populations[1] were built up by cowpea, soybean, two varieties of peanut, and Florida beggarweed. Velvet bean was so severely damaged in the early seedling stage that the roots were destroyed before the nematodes could increase in pot culture. Although the remainder of the legumes showed a low PI average, the presence of larvae, with the exception of crotalaria, indicate that reproduction had occurred and that these crops were capable of carrying over a population. The failure to find larvae under crotalaria suggests that reproduction was inhibited.

The difference in the PI of peanut varieties agrees with Miller's observations (10).

The members of the grass family tested all proved to be suitable for building up sting nematode populations. The low average index under Dallis grass and crowfoot grass was probably due to the slow germination and growth of the seedlings. However, in some individual pots the readings were medium to high.

In the Solanaceae and the Cucurbitaceae, no larvae were observed under tobacco and watermelon. A few larvae were present under hot pepper. Although moderate to high populations were observed under tomato, bell pepper, squash, and watermelon, there was no conspicuous root breakdown or root injury at the end of two or two and one-half months.

Cotton, strawberry, and sweetpotato allowed population increases. The severity of the initial attack and the amount of new roots produced seemed to affect the population under the

[1] For the sting nematode a PI of 15 or above is considered as high; 10 to 14 as moderate, and 9 or below as low. A PI of 15 would represent an estimated population of one nematode per cubic centimeter of soil.

Table 1. Population trends of the sting nematode under different crops and weeds.

Crop	Variety or species	No. of tests	Population index[a] Individual pots Highest	Individual pots Lowest	Average all pots
LEGUMINOSAE					
Crotalaria	Giant Striata	4	7	0	1[b]
Cowpea	Iron	3	46	9	21
Cowpea	Calhoun Crowder	4	100	9	36
Soybean	Bansei	3	67	15	39
Peanut	Unknown	1	32	12	20
Peanut	Improved Spanish	3	7	0	3
Peanut	Valencia	1	34	19	26
Kobe lespedeza		3	10	1	5
Crimson clover		3	20	4	10
Ladino clover		3	24	1	8
Velvet bean	Selection of Osceola	2	7	0	5[c]
Florida beggarweed	Desmodium tortuosum	1	75	34	55
Hairy vetch		2	19	1	7
GRAMINEAE					
Corn	NC-27	3	83	11	32
Oats	Fulgrain	3	96	1	40
Rye	Abrizzia	2	96	17	44
Wheat	Coastal	2	100	9	41
Barley	Calhoun	2	43	10	32
Fescue	Alta 144	2	92	13	61
Bermuda grass	Cynodon dactylon	3	34	1	16
Dallis grass	Paspalum dilatatum	2	24	1	6
Crab grass	Digitaria sanguinalis	3	42	1	17
Crowfoot grass	Dactyloctenium aegyptium	1	16	4	9
SOLANACEAE					
Tobacco	Gold Dollar	5	5	0	1[b]
Tomato	Rutgers	2	26	9	15
Hot pepper	Long Cayenne	3	9	0	3
Bell pepper	California Wonder	2	26	0	14
CUCURBITACEAE					
Watermelon	Garrison	4	5	0	1[b]
Cucumber	A & C	2	38	5	24
Squash	Summer Straight Neck	2	64	11	24
MISCELLANEOUS CROPS					
Cotton	Coker 100WR	3	74	1	38
Strawberry	Unknown	2	36	4	14
Sweetpotato	Porto Rican	2	33	1	12[c]
MISCELLANEOUS WEEDS					
Ragweed	Ambrosia artemisiifolia	4	41	0	13
Jerusalem oak	Chenopodium ambrosioides	2	1	0	0
Cocklebur	Xanthium sp.	4	23	0	9
Horseweed	Erigeron canadensis	2	1	0	0

[a] Index of 15 equals estimated population of one nematode per cubic centimeter of soil.
[b] No larvae observed
[c] Root damage so severe that population remained low.

latter two, especially sweetpotato. When vine cuttings of sweetpotato were used, the root system failed to develop enough to overcome the initial attack resulting in a low PI. A high index was produced in a second test when well-rooted slips were used.

Ragweed and cocklebur, usually referred to as "nematode-resistant," maintained a sting nematode population. Jerusalem oak and horseweed reduced the population but these plants were not checked for the presence or absence of larvae.

In a few tests, the PI failed to rise under the susceptible check plants[2]. Although the data from these tests were discarded, it is interesting to note that a high population (average PI of 39) built up in one test with lettuce, variety Great Lakes, without showing obvious signs of root injury.

The field soils used had other parasitic nematodes present at the beginning and at the end of the tests. Therefore, except where roots were apparently healthy, pathological observations were deferred until single species cultures can be used for study.

Field Observations

The information obtained in these greenhouse trials has been an aid in interpreting field observations made over the past three years.

Tobacco and watermelon have shown no evidence of damage when planted on sting nematode-infested soil in the field.

A so-called "nematode-resistant" cowpea grown for hay in a rotation caused a drastic reduction of a subsequent crop of cotton when compared with cotton following cotton in the adjacent row. A similar effect was observed on corn when half the field was preceded by soybean. Following a crop of soybean, crotalaria failed to make a stand when planted in May.

The damage to corn, soybean, and sweetpotato was still obvious when preceded by a crop of resistant tobacco and a winter oat cover crop.

Although winter grains build up the population in the greenhouse, oat crops have failed to show obvious field damage on fields with spotty infestations.

The fact that wilt-resistant cotton may be completely eliminated from large field areas by the wilt-nematode combination does not seem to decrease the intensity of the damage the following year. This is probably due to the survival of the sting nematode in the soil until after lay-by time when crab grass and crowfoot grass come up and fill the denuded areas.

Observations and samples taken in a field that had been planted with tobacco in 1951 and with crotalaria in 1952 revealed that crab grass and the sting nematode were still present in the best stands of crotalaria. In a greenhouse test, crotalaria alone was compared with a mixture of crotalaria and two plants of crabgrass. The nematode disappeared from pots containing crotalaria but was able to maintain itself in pots with the crab grass-crotalaria combination.

Discussion

The foregoing information from greenhouse trials indicates that the sting nematode may be maintained or show large population increases on a wide variety of hosts, including both cultivated crops and native weeds. The known devastating effects of this nematode on the few hosts on which it has been carefully studied, and the results of these tests, emphasize the possible serious consequences of this pest to agricultural crops in the South.

Crab grass is an important host in maintaining the sting nematode in infested fields. To be effective, the resistant crop in the rotation must be kept free of crab grass and other weeds. This should be kept in mind when rotations utilizing tobacco, watermelon, and crotalaria are tried.

Rotations as a means of control require much more study with regard not only to resistant crops but also to those crops which maintain the parasite and show no signs of damage.

Summary

Greenhouse studies reveal that populations of the sting nematode can build up under: cow-

[2]Factors which may influence population trends in greenhouse tests are: (a) the volume of new root growth which might be influenced by the severity of the initial attack or the rate of germination and growth of plant after seeding, (b) the tendency of some soils to become waterlogged, and (c) presence of parasites. Three different fungi, which are probably parasitic on the sting nematode, have been observed.

pea, soybean, two varieties of peanuts, Florida beggarweed, corn, oats, rye, barley, fescue, Bermuda grass, crab grass, tomato, bell pepper, cucumber, squash, cotton, strawberry, and sweetpotato. A population can be maintained or carried over on Improved Spanish peanut, Kobe lespedeza, crimson clover, ladino clover, velvet bean, Dallis grass, crowfoot grass, hot pepper, ragweed, and cocklebur. The population was reduced by Jerusalem oak, horseweed, tobacco, watermelon, and crotalaria. A thorough check of the three last named failed to reveal the presence of larvae, suggesting that reproduction had been inhibited.

Field observations revealed that soybean and cowpea increased the severity of the trouble on the next crop. Crab grass is largely responsible for maintaining an infestation.

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SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION AND U. S. DEPARTMENT OF AGRICULTURE COOPERATING, FLORENCE, SOUTH CAROLINA

QUICK VIRUS INOCULATION BY RUBBING WITH FRESH LEAF DISCS

C. E. Yarwood

Hoyman (2) and McWhorter (3) have reported quick methods of virus inoculation. In the method here described, which most closely resembles that of Hoyman, one or more 11-mm. diameter discs (four is about the optimum number, size is not important) were cut from leaves of the donor source with a cork borer, stacked one on top of another, held by means of cover-glass-forceps with the cut edges protruding, trimmed to a straight edge with a scalpel, and rubbed over the carborundum-dusted and K_2HPO_4-sprayed suscept surface. In inoculations made at high temperatures, leaf injury was reduced if the inoculum mixture was washed off soon after application. In this method the donor tissue is handled only with cork borer, forceps, and scalpel, each of which can be flame sterilized.

The method has been used in quick testing of a series of sunflower plants inoculated with tobacco mosaic and/or tobacco ring spot viruses, both of which may cause systemic infection of sunflowers without obvious symptoms. When sunflower-leaf discs were used to inoculate bean leaves, it was possible to determine in three days whether the sunflower tissue was infected with tobacco mosaic virus (small, necrotic local lesions without systemic infection) or tobacco ring spot virus (larger necrotic local lesions followed by systemic necrosis), or both. The average time required to make one in a series of such inoculations was 40 seconds for each donor source, compared with 140 seconds when the inoculum was prepared by grinding in a mortar and applied with a brush.

Perhaps a greater advantage than economy of time is the high success with two unstable viruses. The unstability of the tomato spotted-wilt virus has been studied by Bald and Samuel (1). In the present study, most inoculations with this virus from tobacco to bean by the juice-carborundum method have been unsuccessful. Use of K_2HPO_4 (5), and quick drying (6), have greatly increased the success of juice inoculations, but quick inoculations with leaf tissue discs have been consistently more successful than the best juice inoculations. In three trials on Pinto or Bountiful beans, the numbers of lesions resulting from inoculations by the juice-carborundum-phosphate method were 3, 6, and 71, while the numbers of lesions on the opposite leaves inoculated by the quick tissue method were 83, 98, and 267, respectively.

Apple mosaic in California has been described by Thomas (4). No apple mosaic virus or infectious virus from apple is known to have been transmitted mechanically. In this study inoculations with juice from a mosaic apple from Tulare County have frequently yielded necrotic lesions on Bountiful bean, Pencil Pod bean, and Blackeye cowpea, and systemic infection on cucumber, tobacco, and tomato, but results have been erratic and many such inoculations have failed. Systemic infections of tobacco have provided a more potent source of the virus than has apple, but even from such infected tobacco plants, juice inoculations frequently failed. One important reason for these failures is believed to be the unstability of the apple mosaic virus in vitro. In three trials the maximum period during which infection could be secured from juice was 16 minutes.

Inoculations with this apple mosaic entity by the quick tissue method described here have been highly successful. In three trials the numbers of lesions on Bountiful or Pencil Pod beans by the juice method with carborundum and K_2HPO_4 were 1, 0, and 3, while the corresponding numbers of lesions on the opposite leaves inoculated by the quick tissue method were 597, 583, and 1401.

Quick inoculation with leaf tissue from 15 other woody plants showing virus-like symptoms has not yielded certain symptoms on bean or cowpea, nor has apple mosaic or the above described entity of apple mosaic been transmitted from apple to apple. Part of the latter difficulty may be due to the demonstrated inhibitory action of apple leaf juice in juice inoculations with the above described virus from tobacco to bean.

Inoculation of bean with tobacco mosaic virus from tobacco by the quick inoculation method has yielded much fewer lesions than by the juice method using carborundum and K_2HPO_4.

SUMMARY

Virus inoculation by rubbing the cut edges of leaf discs of a donor source over carborundum-dusted K_2HPO_4-sprayed test leaves has been quicker than by conventional methods and has yielded more infections with two viruses (tomato spotted-wilt and an entity of apple mosaic, both of which are relatively unstable in juice preparation) than have conventional inoculations with leaf juice.

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DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF CALIFORNIA, BERKELEY

TRANSMISSION TRIALS WITH CRINKLE-SCURF OF CITRUS[1]

L. C. Knorr

A citrus budwood certification program has recently been inaugurated in Florida, its chief aim being to improve stocks by eliminating bud-transmissible virus. Since regulations covering the program stipulate that psorosis, xyloporosis, and all other bud-transmissible diseases fall within its purview, renewed interest has lately been shown in a number of abnormalities which appear to be viral. One of these is crinkle-scurf, an undescribed, yet frequently encountered, disorder in Florida groves that produces a crinkling of leaves and a scurfing of bark. The bark symptoms bear a pronounced resemblance to banded corky bark, a disease described by Fawcett and Bitancourt[2] as possibly related to psorosis, but leaf symptoms, the most vivid indication of crinkle-scurf, are not mentioned in connection with corky bark.

Symptoms

In crinkle-scurf two symptom complexes occur, one on the trunk and branches of the scion, and the other in the zone of its twig terminals. Though widely separated in location and type of tissues affected, these two symptoms occur together in approximately 95 percent of the thousand-odd trees examined.

Bark symptoms are obscure and easily overlooked. They are restricted to the scion portion of the trunk and to adjacent parts of main limbs. Scurfing results from the eruption of corky pimples merged to form straight ridges that run crosswise of the long axis of parts affected (Figure 1). The dotted-line effect may occur as a single ridge, but more often patches are formed by the aggregation of many paralleling ridges. These areas vary considerably in extent but on an average are the size of a penknife. Occasionally patches may encircle the trunk or branch. Individual pimples are roughly hemispherical, measure less than a millimeter in diameter, and have the color of normal bark. When the affected bark is shaved tangentially, the underlying cortical tissues are found to be impregnated with a dark brown gummy substance. The discoloration, however, does not penetrate beyond the raised area nor into the wood.

The patches usually occur most prominently on the trunk and diminish in size with distance from the bud union. Only old bark tissue has been found affected. No cases have been seen where rootstocks are involved.

In contrast to the obscurity of bark symptoms, those that appear in the tops are quite conspicuous. Foliage symptoms consist of a marked twisting of leaf blades as shown in Figure 2. Adult leaves of the terminal flush are most noticeably distorted though older leaves do not entirely lose their convoluted appearance.

Besides being distorted, the leaves are also borne abnormally erect and seem to clasp the twigs supporting them. This habit makes the foliage look thin and gives the tree the appearance of suffering from drought. At times the ends of branches develop S-shaped distortions.

Some 15 percent of the twisted leaves, when viewed by transmitted light, show chlorotic areas usually located at the base of the leaf just above the wings (Figure 3). The affected zone may be contiguous to one or both sides of the midrib, and in size may range from narrow streaks to as much as one-quarter of the leaf's surface. These chlorotic islands resemble the oakleaf patterns described for psorosis but differ from them in that crinkle-scurf chlorosis is persistent, lasting at times down to the fourth flush.

Effects of crinkle-scurf on yield have not been measured, but judging from repeated statements by growers and from observations by the author, affected trees seem to bear as satisfactorily as adjacent healthy ones. There is a tendency, however, for fruit on crinkle-scurf trees to be abnormally oval. In one Valencia grove where this tendency was marked, 25 fruits selected at random from normal trees gave a longitudinal/equatorial index of 0.97 whereas the value for 25 fruits from crinkle-scurf trees was 1.07.

Plants Affected

Crinkle-scurf occurs mainly in Valencia and Lue Gim Gong sweet oranges. Another sweet orange, Star Calyx, is affected, but this variety is rarely seen in commercial plantings today.

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[1]Florida Agricultural Experiment Station Journal Series, No. 161.

[2]Fawcett, H. S., and A. A. Bitancourt. 1943. Comparative symptomatology of psorosis varieties on Citrus in California. Phytopathology 33: 837-864.

FIGURE 1. Scurfing of the bark on a Valencia sweet orange tree due to the parallel alignment of rows of corky pimples.

FIGURE 2. Terminal shoot from a Valencia sweet orange tree showing leaves that are twisted and abnormally erect and clasping.

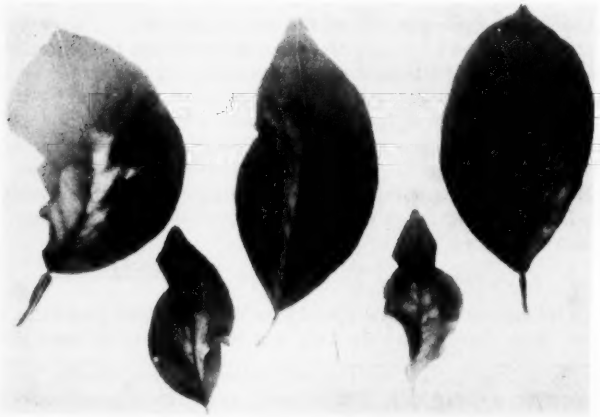

FIGURE 3. Chlorotic areas viewed by transmitted light in leaves distorted by crinkle-scurf. Variety: Valencia sweet orange.

In addition some varieties of tangelos show a similar crinkling of leaves associated with banding of the bark.

In comparing crinkle-scurf with banded corky bark, it is interesting to note that the California report also is based on Valencia orange.

Distribution

Crinkle-scurf may be found in Florida wherever the above varieties are grown. In most groves only an occasional case is seen; in others up to 54 percent of the trees have been found affected. The disorder is not limited to Florida, and while no attempts have been made to discover its presence in other areas, it is known to occur also in Argentina (3).

Cause

Trials were started in 1948 to determine whether crinkle-scurf is bud-transmissible. Budsticks from typically affected trees were collected at various points in Florida including Lake Alfred, Lucerne Park, Lake Hamilton, Sebring, Tampa, Tavares, and Zellwood. Varieties involved were principally Valencia and Lue Gim Gong sweet oranges, though Star Calyx sweet orange and two kinds of tangelos were also included. Buds from these selections were inserted into test seedlings of the varieties sweet, sour, and trifoliate oranges; rough, sweet, and Arizona lemons; grapefruit; tangelo; Cleopatra mandarin; and citron Etrog. Tests were carried out in the greenhouse, in the insect-free screenhouse, and in the nursery. Table 1 summarizes the conditions under which inoculations were performed, and lists the results obtained. The data fall into six groups depending on parts of the test plants present (i.e., whether stock or scion wood or foliage), and on the nature of symptoms occurring in these parts.

Group 1 consists of test plants in which both foliage and wood of the stock and scion were present, and in which foliar and bark symptoms developed only in the scion portions. Fifteen percent of all the test plants fell into this category.

Group 2 comprises those test plants in which the stock foliage was superseded by growth of the scion. The two trees in this class developed symptoms of crinkle-scurf only in the scion bark and foliage but not in stock bark (stock leaves being absent).

Group 3 consists of test plants similar to those in group 2 except that here the stock wood also is not present or at least evident. The three representatives of this class showed symptoms of crinkle-scurf only in the scion wood and foliage.

Group 4 is made up of test plants which, like those in group 1, possess both foliage and wood portions of scion and stock. Group 4 differs, however, in consisting of plants which show symptoms only in scion foliage and not in scion bark. Twenty-two percent of the total test plants fall into this class.

Group 5 contains test plants in which the scion portion did not develop but in which buds from affected trees remained alive for from three days to four years, a third of them for more than a year. In none of the 37 plants (55 percent of the total) representative of this category, did any symptoms appear in stock foliage or bark.

Group 6 comprises plants in which bark and foliage of both stock and scion were present without expressing symptoms. Seven percent of the total test plants occurred in this class.

The results reported in Table 1 give two indications as to the nature of crinkle-scurf: 1, that the disorder is propagated in the scion (cf. the 45 percent of all plants in Groups 1 through 4), and 2, that crinkle-scurf is not transmitted through affected buds to other parts of healthy plants (cf. the failure of stock symptoms to appear in any of the 67 test plants). In other words, whenever blind buds from affected trees were used, no symptoms were transmitted to the plant carrying the bud; but when the buds were allowed to grow, bud shoots showed bark and leaf symptoms, whereas the stock plants remained without foliar and bark symptoms. The data, therefore, do not indicate that a virus is involved, nor can it be said that crinkle-scurf is related to psorosis since none of the leaf symptoms of that virus disease as pictured by Klotz and Fawcett[4] occurred in any but one of the test plants, despite the fact that stock and scion leaves in all stages of growth were examined periodically over a period of four and a half years. The one plant showing psorosis leaf symptoms received buds from a tangelo parent known to have had psorosis.

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[3]Knorr, L. C., and E. P. DuCharme. 1951. Unpublished observations. Tristeza Laboratory, Concordia, E. R., Argentina.

[4]Klotz, L. J., and H. S. Fawcett. 1948. Color handbook of citrus diseases. University of California Press, Berkeley. 119 pp.

Table 1. Summary of details and results of inoculations to determine the transmissibility or propagatability of crinkle-scurf. Figures in body of table represent number of replications.

Group	Symptoms in test plants				Variety of test plant												Length of bud life after unwrapping					Test conducted in			Duration of test				Variety of affected parent							
	Stock foliage	Scion foliage	Stock bark	Scion bark	Sweet orange	Sour orange	Grapefruit	Rough lemon	Sweet lemon	Arizona lemon	Trifoliate orange	Tangelo	Cleopatra Mandarin	Citron Etrog	3 days to 1 month	1 to 6 months	6 months to 1 year	1 to 2 years	2 to 4 years	Greenhouse	Screenhouse	Nursery	1/2 to 1 year	1 to 2 years	2 to 3 years	3 to 4 years	Valencia	Lue Gim Gong	Star Calyx	Unknown	Oranges: No. 40684	Oranges: No. 52018-5-15	Tangelos			
1	O	+	O	+	3			3	3					1			1	9				10		1	6	3	1		8		1			
2	A	+	O	+	1	1												2				2			2				2					
3	A	+	A	+	1								2					3				3			2	1			3					
4	O	+	O	O	2	3		5	2		1		2			1	2	9	3	5		10	2	10		3	8	3		1			3		
5	O	A	O	A	6	1	5	11	1	1		5	3	4	15	7	3	6	6	17	2	18	7	18	1	11	31		5			1		
6	O	O	O	O	3			2								1	2	2				5	2	1		2	4		1					

Key: O = No symptoms of crinkle-scurf -- i.e., normal.
+ = Symptoms of crinkle-scurf: in foliage a twisting of leaves, and in bark a scurfing of the surface.
A = Indicated part of the plant is absent.

The data conform rather to what might be expected of a somatic mutation that is bud-propagable. To test whether crinkle-scurf can also be inherited through the seed, fruits of Valencia oranges were collected from affected branches and their seeds extracted and planted. The resulting seedlings were examined at periodic intervals for the symptoms of crinkle-scurf. At the time of the last observation the plants were four years old and ranged in height from 4 to 7 feet, and in trunk diameter from 1/2 to 2 inches. At no time did the leaves of any of the 91 seedlings show abnormal twisting, nor was the bark affected by scurf. It appears, therefore, that reproductive tissues in affected limbs are not influenced by the somatic change.

In this connection it may be of interest to mention another disorder of Valencia oranges previously described[5] under the name "popped bark". The leaves in this disorder are distorted in the same way as in crinkle-scurf. A pebbling of the bark is also present but instead of occurring on the trunk or bases of large branches, the eruptions appear in the twigs, the petioles, and on some of the leaves. In addition the individual blisters are much larger and are not aligned to form straight ridges. In contrast to the situation in crinkle-scurf, it was found that in popped bark the abnormality does pass through the seed. Seedlings three and a half years old showed heavy corky pimpling along the stems from the groundline up into the leaves, the latter being peppered by the eruptions on their abaxial surfaces.

Conclusions

Crinkle-scurf is a disorder of citrus, the importance of which does not arise from losses in production nor from weakening effects to the tree. Neither does the trouble behave like an infectious disease. Its importance does stem, however, from the fact that symptoms are propagable in shoots from affected buds. Therefore, it is necessary that prospective bud sources be examined for crinkle-scurf. Trees found affected should be avoided in the interest of maintaining varieties true to type.

STATE PLANT BOARD OF FLORIDA, CITRUS EXPERIMENT STATION, LAKE ALFRED, FLORIDA

[5]Knorr, L. C. 1950. Citrus tumors, knots, and galls. Citrus Magazine 12(11): 16-18.

WESTERN X-DISEASE OF PEACH IN ARIZONA

Paul D. Keener

Experimental evidence confirming the existence of western X virus in peaches in Arizona apparently has not been previously recorded. The disease is known to occur in the neighboring States of Colorado, Idaho, Utah, and California, as well as in other areas such as Oregon, Washington, and British Columbia.

Field symptoms suggestive of western X-disease have been observed by numerous investigators from season to season over the past several years in the scattered peach growing areas of the State. The only previous record which might be construed as constituting a definite report on the suspected occurrence of western X-disease in Arizona was made by Manfred Gottlieb in 1940. This record concerning "Southwestern Yellows" in peach, is a Plant Disease Survey card in the files of the Department of Plant Pathology, University of Arizona, Tucson, and reports a 12 percent reduction in yield, with a maximum infection in any one area of 100 percent. No locations for these observations are mentioned.

In mid-summer of 1952, six partially defoliated Elberta peach trees in an orchard in the Oak Creek Canyon area of the State were found which had all the appearances of being infected with some strain of western X-disease virus. The few fruits remaining on some of the trees at the time of the first observations were small, shrivelled, and exceedingly insipid in taste. Other trees of the same and different varieties, in the same orchard, appeared to have milder symptoms of a similar nature.

Twigs with buds from one of the six severely infected trees (Fig. 1), were removed on September 22, 1952 and buds were grafted onto a symptomless seedling peach. Another seedling peach tree received bark patch grafts. Two other seedling peaches were inoculated by means of grafted scions from another orchard tree that showed only mild symptoms.

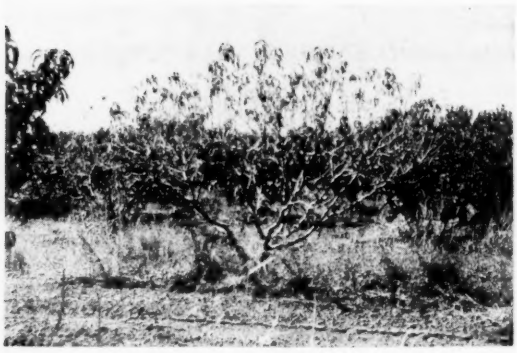

FIGURE 1. Partially defoliated Elberta peach tree which served as a source of some of the inoculum in western X-disease studies. Oak Creek Canyon, Coconino County, Arizona. September 22, 1952.

Late frosts and unseasonably cool weather during the spring and early summer of 1953 delayed new growth of all fruit trees in the Oak Creek Canyon area. By August 14, 1953, however, the two trees that received buds and bark patch grafts from one of the original severely infected orchard trees (Fig. 1), showed definite symptoms of western X-disease virus in Elberta peaches[1]. The most striking symptoms were unilateral on the side branches that had received the most bud and bark patch grafts in 1952. On this date, other portions of the inoculated trees appeared a healthy green, in sharp contrast to the portions showing symptoms. The leaves on infected branches were rolled upwardly from the margins towards the mid-ribs. A yellow-bronze discoloration was quite evident in many leaves. Numerous leaves on the lower branches showed random distribution of dark purple-red spots, some of which had lost their centers, presenting a typical "shot-hole" effect. The two trees inoculated from scions from mildly infected original trees showed no symptoms when examined on August 14, 1953. One of these trees became severely infected with peach mosaic, the virus of which may have hindered western X-disease symptom expression, while the other specimen was badly mutilated by highway crews.

The appearance of western X-disease symptoms in two peach seedlings experimentally inoculated with buds and bark patches from an original severely infected Elberta tree in an orchard in Oak Creek Canyon (Coconino County), establishes the existence of western X-disease in Arizona.

DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF ARIZONA, TUCSON

[1] Virus diseases and other disorders with viruslike symptoms of stone fruits in North America. United States Department of Agriculture Handbook No. 10, April 1951.

REDUCTION IN INCIDENCE OF PEACH SCAB AS AFFECTED BY WHITEWASHING TREES

Glenn KenKnight and Julian F. Jones[1]

It has been noted frequently that peach trees receiving the lead arsenate-sulfur spray schedule have less scab [Cladosporium carpophilum] on the fruits than do trees receiving the sulfur-parathion spray schedule. During the 1953 peach harvest season in Georgia, rather severe scab infection was reported by many growers who used the sulfur-parathion schedule. For this reason, a reduction in the incidence of scab in an experimental plot of eight-year-old Elberta peach trees sprayed with whitewash appears worthy of mention. The planting is located at the U. S. Horticultural Field Laboratory, Fort Valley, Georgia.

In connection with research on the phony peach virus disease five trees in each of 12 replicated plots were whitewashed (67 lbs. of hydrated lime to 100 gals. of water) on April 29, May 22, and June 29, 1953. Twelve similar plots of five trees each (check plots) were not whitewashed. All trees in the experiment received four applications of wettable sulfur at the rate of 6 lbs. per 100 gals. of water, with 2 lbs. of 15 percent parathion supplementing each of the first three sulfur applications. The first two sulfur-parathion sprays were applied on or about March 24 and April 15. The third sulfur-parathion spray was applied June 1, and the last (sulfur alone) on June 29. Petal fall occurred about March 15, and the fruit was shipping-ripe on July 9 to 12.

At the time of the June 29 spray, a marked difference in incidence of scab between whitewashed and check plots was noted. On July 2 or 3, scab counts were made on 20 fruits picked at random from each tree in the experiment. In the whitewashed plots, 46.1 percent of the fruits were infected with scab, whereas 87 percent of the fruits in the check plots were infected. Further, only 6 percent of the former had 25 or more scab spots as compared with 21.3 percent for the fruits from the check plots. By analysis of variance, the required differences for statistical significance at odds of 99:1 are 14.76 and 3.86, respectively. Because of a greater number of very scabby fruits in the check plots, the average difference in number of scab spots per fruit in whitewashed and in check plots was in the ration of 1:6.

U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, FORT VALLEY, GEORGIA

[1]Plant pathologist and agricultural aid, respectively, U. S. Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering, Fort Valley, Georgia.

DISEASES CAUSING PARTIAL OR TOTAL LOSSES TO PECAN TREES OR NUTS IN THE SOUTHEASTERN STATES WHERE NO CONTROL MEASURES ARE EMPLOYED

John R. Cole

Pecans are considered by some economists to be a minor crop, but are actually a major cash crop for many farmers in the southeastern States. That is especially true in Georgia, where pecans annually bring in 10 million dollars to farmers scattered through most sections of the State.

Some of the chief obstacles in pecan production are fungus, bacterial, and nutritional diseases. The most severe of all these is scab, caused by the fungus Cladosporium effusum. This disease attacks such established varieties as Schley, Moore, Mobile, Moneymaker, Van Deman, Alley, Delmas, Mahan, and Brooks in many localities. Furthermore, a total loss of nuts on many of these varieties results from scab during years when weather conditions favor the development and spread of the causal fungus. The year 1953 has been such a year and a complete spray schedule has been required to control this disease. Furthermore, where no sprays are applied, defoliation has occurred so early that no crop is likely to set in 1954.

1953 weather has been very erratic in the Southeast. Rainfall for April and May was above normal while in June rainfall was deficient and temperatures were above normal. At Albany, Georgia, showery weather began the latter part of June and continued through July. During this period the temperatures were below normal, and rain, which fell on 22 days in July, was above normal. There was one continuous period of rainfall of 6 days and another of 12 days. In addition, on 17 of these days the rains occurred in late afternoons. Therefore, scab spread rapidly during July and August, probably causing a loss of 5 to 10 million pounds of nuts on susceptible varieties. Furthermore, a disease known as pink rot, caused by Cephalothecium roseum, a saprophytic fungus, is present on many of these scabby nuts, especially Schley. Since this fungus is able to penetrate the shell of the thin-shell varieties and cause a decay of the kernel, there will probably be huge losses to pecan growers from pink rot also.

Control measures for scab and pink rot include four or more spray applications of low-lime bordeaux mixture (6-2-100), Zerlate (2-100) plus one quart of summer oil emulsion, or Dithane Z-78 (2-100) plus one quart of summer oil emulsion. In addition, captan 50W (2-100) plus 8 pounds of sulfur, Vancide 51-ZW (2-100), and 50-CS-46 N-ethylmercuri-"hex"-maleimide (2 ounces-100), are being used in "spot-spraying" tests. However, the results for the last three fungicides are incomplete at the time this report is written and they are not yet recommended.

Among other diseases of less economic importance is crown gall (Agrobacterium tumefaciens), which attacks the crown and lateral roots of the tree. Control measures include destruction of diseased trees in the nursery and omission of cultivation near trees where roots would be cut, as well as the painting of diseased tissues with a mixture of one part creosote to three parts coal tar annually until the affected tree has recovered.

Foliage diseases causing minor to serious damage to the pecan crops are downy spot, caused by Mycosphaerella caryigena; pecan leaf blotch, caused by Mycosphaerella dendroides; powdery mildew, caused by Microsphaera alni; and brown leaf spot, caused by Cercospora fusca. Where growers are spraying to control scab the same spray materials and applications will also control these foliage diseases, but where growers are not spraying to control scab or on varieties that are resistant to scab, such as Stuart, the first and second cover spray applications in the recommended spray schedule will usually give commercial control.

Growers not prepared to spray for the control of foliage diseases may reduce infections by removing the low branches from their trees. Thinning the stand of trees in orchards where the trees are crowding is of great help in preventing infection and in the control of disease.

Of the nutritional diseases, rosette (zinc deficiency) and leaf scorch (cause unknown) are the most important. Rosette may be overcome or prevented by soil or spray applications of zinc sulfate, but there are as yet no recommended control measures for leaf scorch. Nevertheless, unsprayed Schley trees in the writer's scab test plots near Fort Valley, in 1952 were severely scorched; trees sprayed with bordeaux mixture sustained less scorch than unsprayed trees; while trees sprayed with either Zerlate or Dithane Z-78 had scorched leaves only in the tops. Presumably these scorched leaves were those that were not covered with spray material during regular spraying operations. It appears as this report is written that this leaf scorch might occur again this year over a wide area of Georgia.

U. S. BPISAE PECAN FIELD STATION, ALBANY, GEORGIA

ARTICULARIA AND MICROSTROMA ON PECAN IN OKLAHOMA

Richard H. Converse

Articularia quercina (Pk.) Hoehn. var. minor Charles has been collected on pecan three times in Texas, in 1900 and 1933 (1), and in 1950 (2). The fungus has not been reported on pecan elsewhere. In October, 1951, two mycology students collected diseased pecan leaves near Stillwater, Oklahoma. The author found these specimens to be infected with A. quercina var. minor. In October, 1952, the author found this fungus in abundance on leaves of the pecan varieties Halbert and Burkett in the Stillwater area. The fungus again appeared on Burkett leaves in August, 1953, in Stillwater. Spore measurements agreed closely with those of Charles (1), and symptoms were similar to those she described. A previously unrecorded symptom, the brick-red appearance of lesions on the upper leaf surface of fresh material, was noted.

Microstroma juglandis (Bereng.) Sacc. has been found causing a white leaf spot on leaves of pecan from Georgia to Texas and from a widespread area on various other hickory (Carya) species (4, 6). It has been reported to cause witches' brooms on Carya ovata in New York (5). Higgins (3) reported a blight of pecan catkins in Georgia caused by Microstroma juglandis (Bereng.) Sacc. var. robustum Higgins. On the basis of conidia, conidiophore, and stromata size and cross-inoculation tests Higgins found that this catkin blight fungus was distinct from the Microstroma on hickory; and the fungus was not found on pecan leaves. Higgins' original description constitutes the only published report of the fungus.[1]

In May, 1953, a catkin blight was found throughout the east-central pecan-growing area of Oklahoma, occurring with varying intensity on all important pecan varieties and on many native pecans. The causal fungus was identified as M. juglandis var. robustum, even though spore measurements (Table 1) were smaller than those of Higgins, and there were also some differences in disease symptoms.

Table 1. Measurements of Microstroma spores obtained from several sources.

Source	Average spore dimensions Microns
Higgins (3), M. juglandis	6-8 x 4.5
Higgins (3), M. juglandis var. robustum	9-14 x 3-5
Pecan catkins, Stillwater, Oklahoma	$6.9 \pm 1.4 \times 2.7 \pm 0.3$
Pecan leaf, Stillwater, Oklahoma	$7.8 \pm 1.5 \times 2.7 \pm 0.3$
Carya texana leaf, Stillwater, Oklahoma	$5.5 \pm 1.0 \times 3.0 \pm 0.4$

The fungus invaded catkin rachis tissue as well as stamens and bracts. Well-established lesions were necrotic, and in cases of severe infection as much as one-half of the catkin became brown and blighted.

In early June, 1953, Microstroma sporulation was observed in a few cases on necrotic leaflets (Figure 1) of the pecan varieties Western and Burkett in Stillwater, Oklahoma. Symptoms were confined to leaflet tips, to the larger veins and to adjoining blade tissue. Spore measurements were similar to those made on catkin material (Table 1). Higgins reported that spores of M. juglandis var. robustum from pecan catkins were longer and more cylindrical than those of M. juglandis from hickory leaves. The author found that spores from pecan catkins and and pecan leaves were also longer and more cylindrical than those from hickory leaves. It seems probable that the pecan leaves are infected by the same fungus as are the catkins.

[1] After this paper had been submitted, the author learned that a pecan catkin blight, indistinguishable from that found in Oklahoma, has been observed from time to time by Mr. L. D. Romberg at the USDA Pecan Field Station at Brownwood, Texas, and elsewhere in Texas for anumber of years. The amount of catkin infection varied greatly with the season.

FIGURE 1. Microstroma juglandis var. robustum on pecan leaf, variety Western.

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OKLAHOMA AGRICULTURAL EXPERIMENT STATION, DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, STILLWATER, OKLAHOMA, AND DIVISION OF FRUIT AND NUT CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, AGRICULTURAL RESEARCH ADMINISTRATION, U. S. DEPARTMENT OF AGRICULTURE

BOTRYTIS SPOT OF ONION LEAVES IN ONTARIO

O. T. Page

A foliage disease of onions has been prevalent in the Holland-Bradford Marsh, Ontario, during the 1952 and 1953 growing seasons. A similar field condition was first observed by the author in the Garner and Fertile districts of Iowa in 1951. The disease symptoms closely agree with those described in England by Hickman and Ashworth (2) who attributed the disease to three species of Botrytis. The predominant fungus isolated in their investigations was Botrytis squamosa. Similar symptoms have been recorded by Yarwood (8) who demonstrated that Botrytis cinerea may infect onion leaves and seed stalks. Walker (6) has reported that Botrytis allii and Botrytis byssoidea "may cause small, white necrotic lesions on leaves and seedstalks". Viennot-Bourgin (5), who observed a firing of the leaf tips of white onion in the winter of 1951-52 near Rennes, France, considered Botrytis squamosa to be the causal agent.

Affected onion leaves observed by the author (Fig. 1) exhibited discrete, elliptical, greyish-white necrotic spots generally with sharply-defined margins. Such lesions were slightly sunken and were characteristically associated with a progressive wilting and drying of the tips, particularly of the outer leaves. The exposed portion of the inner leaves of vigorously growing plants may exhibit discrete spots unaccompanied by tip wilting. Similar disease symptoms have been observed on the leaves of yellow, red, and white bulbing onions.

FIGURE 1. Early Yellow Globe onions showing symptoms of Botrytis leaf spot. Approximately one-third natural size.

Sclerotia have not been observed in the field during the growing season except for the presence of occasional squamose sclerotia on the bulbs of White Globe onions. Samples of infected tops of Early Yellow Globe onions, left in a field following mechanical harvesting, were examin-

ed periodically during the interval from September 1952 to April 1953, but no sclerotia were found. Samples of bulbs from the same field were examined after three and six months in storage at 32° F. and less than 1 percent of the bulbs examined were infected with Botrytis allii. Mycelial neck rot and small sclerotial neck rot were not observed on yellow onions in storage. The absence of sclerotia on diseased leaves in the field is in agreement with the observations of Hickman and Ashworth (2). Viennot-Bourgin (5) found no sclerotia of Botrytis squamosa on the desiccated leaves of white onion.

The development of symptoms of Botrytis leaf spot was observed at approximately weekly intervals in the same field of Early Yellow Globe onions during the 1952 and 1953 seasons. In 1952, the sudden outbreak of the disease occurred during the interval from August 14 to August 20, although the occasional diseased onion leaf had been previously noted. Similarly, during the interval from July 27 to August 1, 1953, the disease occurred simultaneously in adjacent fields of Early Yellow Globe, Brigham Yellow Globe, and White Globe onions. Although downy mildew, Peronospora destructor, was absent during the 1952 season and prevalent during the 1953 season, the incidence of Botrytis spot of onions during both years was much the same. Hickman and Ashworth (2) have observed "that Botrytis infection was sometimes associated with mild attack by downy mildew".

Jones (3) has described a foliage blast or sunscald of onions which is apparently physiological and results from "the inability of the onion plant to adjust itself immediately to bright sunshine, high temperature, and low relative humidity, following a period of cloudy, wet weather concomitant with high temperature and high relative humidity". Jones was unable to demonstrate the association of a pathogen when blast symptoms were first exhibited by the plant. Newhall and Rawlins (4) have shown that certain carbamate sprays may control blast and are of the opinoin "that much of what has been called blast for years may very well have been due to fungi hitherto believed of little importance". It is believed by the author that blast symptoms as described and illustrated by Jones (3) may indeed overlap the symptoms caused by Botrytis. However, the widespread association of Botrytis squamosa with leaf spots and tip wilting observed over a period of three consecutive seasons under varying weather conditions strongly suggests this fungus as a causal agent.

Repeated mycelial and conidial isolations have been made from the margins of leaf spots during the past three years. On potato dextrose agar the most commonly isolated organism, Botrytis squamosa, produced numerous small sclerotia. Conidiospores and conidia were subsequently formed, usually upon sclerotia, after storage for several months at 10° C. The appearance of the septate conidiophores closely agrees with the description of Walker (7), with typical accordion-like folds in degenerated side branches. Conidia produced by the organism on P.D.A. range in size from 12.0-22.5 X 9.0-18.0 microns, mean 18.4 X 12.9 microns. Apothecia as reported by Cronshey (1) have not been observed in culture.

Greenhouse inoculation experiments in which conidial and pulverized sclerotial suspensions of Botrytis squamosa were sprayed on the leaves have been generally unsuccessful. Moderate spotting of the leaves has been induced in the greenhouse and in one instance squamose sclerotia were produced on excised leaves which were allowed to desiccate in a moist chamber.

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DEPARTMENT OF BOTANY, ONTARIO AGRICULTURAL COLLEGE, GUELPH, CANADA

CROSS-INOCULATIONS WITH NEW JERSEY ISOLATES OF SCLEROTINIA SCLEROTIORUM, S. MINOR, AND S. TRIFOLIORUM[1]

Victor M. Held[2] and C. M. Haenseler

Introduction

Under field conditions, repeated growing of a susceptible crop tends to increase the severity of Sclerotinia damage, but occasionally destructive outbreaks have been observed on a crop planted in a given locality for the first time. Specifically, lettuce has been severely attacked by Sclerotinia following its initial planting on fields previously sown to clovers and alfalfa. This observation led to the hypothesis that lettuce may be susceptible to forms of Sclerotinia which attack forage legumes. It seemed of particular interest to determine whether Sclerotinia trifoliorum Erikss. could incite lettuce drop, a disease usually attributed to S. sclerotiorum (Lib.) D By. and S. minor Jagger. At the same time it was decided to observe the course of attack of these three pathogens on a variety of crops under controlled environmental conditions.

In New Jersey, Sclerotinia minor frequently destroys more than 50 percent of the lettuce crop in specific fields in the southern part of the State. It also occurs, but is less destructive, in the northern counties. On the other hand, S. sclerotiorum causes damage in fields and cold-frames throughout the State.

Sclerotinia trifoliorum causes occasional extensive damage to red clover, crimson clover, Ladino clover, and alfalfa. It has also been isolated from alsike clover.

Sclerotinias are also occasionally found on beans, crucifers, celery, tomatoes, and sweet-potatoes, and more rarely on a variety of other crops and weeds.

Materials and Methods

All isolates were obtained from sclerotia collected on plants attacked by Sclerotinia in New Jersey in the spring of 1950. Sclerotia of S. sclerotiorum and S. minor were collected from lettuce growing in Cumberland County, in a locality where the crop had suffered yearly damage from these pathogens. Isolates of S. trifoliorum were obtained from sclerotia collected in a field, also in Cumberland County, where a mixture of alfalfa and Ladino clover had been planted. Both the alfalfa and the clover were severely affected with crown rot.

The sclerotia were immersed in 1:1000 mercuric chloride solution, rinsed in sterile water, cut open with a sterile scalpel, and planted on potato-dextrose agar. The actively growing mycelium thus obtained was used to start cultures of grain inoculum.

Identification of the organisms was an important step. There was no difficulty in identifying Sclerotinia minor: the smallness of its sclerotia compared with those produced by the other two species in culture distinguishes it beyond a doubt. On the other hand, S. sclerotiorum and S. trifoliorum cannot be separated on the basis of sclerotial measurements, and proof of identity was desired beyond the fact that the former is usually found on lettuce, and the latter on forage legumes. The two organisms differ in ascus and ascospore dimensions, but Miss Keay (1939)[3] noted several distinctive cultural characteristics also. On the basis of these cultural characteristics, it was ascertained that the large sclerotial type from lettuce was S. sclerotiorum and the isolates from clover and alfalfa were S. trifoliorum. The writers find that the most outstanding cultural difference between the two organisms is the production by S. trifoliorum of holdfasts which extend from the medium to the glass of the test tube or Petri-dish. These holdfasts are black, membranous structures often resembling folded fans with their ends flattened against the glass. Of the numerous S. trifoliorum isolates studied since the thesis was written, none has varied in this respect. These structures develop best on oatmeal agar, but will arise on potato-dextrose agar, Czapek's agar, 5% malt-extract agar, and many other artificial and synthetic media. The most favorable temperature seems to be in the range 15° to 20° C.

Grain inoculum of each organism was made by growing in quart bottles in each of which a

[1]Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, the State University of New Jersey, Department of Plant Pathology. This article is based on a thesis submitted by the senior author to Rutgers University, June, 1951, in partial fulfillment of the requirements for the degree of Master of Science.

[2]Research Assistant in Plant Pathology, U. S. Regional Pasture Research Laboratory, State College, Pennsylvania.

[3]Keay, M. A. A study of certain species of the genus Sclerotinia. Ann. Appl. Biol. 26: 227-246. 1939.

mixture of 250 gm. wheat kernels, 250 ml. water, and 4 gm. calcium carbonate had been autoclaved for one hour at 15 lb. pressure. After three weeks' growth, the inocula were air dried and stored at 5° C until used.

All test plants were grown in clay pots or flats in the greenhouse. Experimental hosts included clover, alfalfa, lettuce, cabbage, spinach, beet, Swiss chard, snap bean, soybean, tomato, pepper, cantaloupe, oats, corn, tobacco, stock, and phlox. This is a representative group of plants including forage legumes, leafy and leguminous vegetables, crucifers, solanaceous plants, grains, and herbaceous ornamentals.

A number of plants of each species tested was inoculated with each of the three Sclerotinias. To assess the relative virulence of the pathogen on the host species, a record was kept of (a) age of plants, (b) date of inoculation, (c) species of Sclerotinia used, (d) time in days from inoculation to the appearance of the first morphological symptoms, (e) time in days from inoculation to the development of severe symptoms, and (f) time in days from inoculation to collapse of the plant.

Inoculations were made by placing a uniform quantity of grain inoculum in contact with the plants. Sterile wheat kernel medium was placed on check plants. During the tests the plants were maintained at a mean temperature of 15° C at a relative humidity of 98 to 100 percent.

Observations

Table 1. Reaction of experimental host plants to inoculation with New Jersey isolates of Sclerotinia spp.[a]

Host	S. minor	S. sclerotiorum	S. trifoliorum
Alfalfa	+++	+++	+++
Red clover	+++	+	+++
Lettuce	+++	+++	+++
Swiss chard	+++	+++	0
Spinach	+++	+++	0
Beet	+++	0	0
Cantaloupe	+++	+++	0
Cabbage	+++	+++	+
Tomato	+++	+++	+++
Pepper	+++	+++	0
Snap bean	+++	+++	++
Soybean	+++	+++	++
Oats	0	0	0
Corn	0	0	0
Tobacco	+++	+	0
Stock	+++	0	0
Phlox	+++	+	0

[a] (0) no symptoms; (+) mild; (++) severe; (+++) plant killed.

As shown in Table 1, Sclerotinia minor was the most virulent pathogen under the test conditions. It killed all of the test plants except oats and corn, which were immune. It killed alfalfa and red clover more rapidly than did S. trifoliorum. Plants killed by both S. minor and S. sclerotiorum succumbed more rapidly to S. minor except for pepper, snapbean, and soybean, which were killed in the same number of days by the two fungi.

Sclerotinia sclerotiorum killed alfalfa, lettuce, Swiss chard, spinach, cantaloupe, cabbage, tomato, pepper, snapbean, and soybean. It produced a mild infection on red clover, tobacco, and phlox. It failed to infect beet, oats, corn, and stock.

Sclerotinia trifoliorum killed alfalfa, red clover, lettuce, and tomato; severely infected snapbean and soybean; produced local lesions on cabbage; and failed to infect Swiss chard, spinach, beet, cantaloupe, pepper, oats, corn, tobacco, stock, and phlox.

Discussion

It must be noted that the tests were conducted in an environment highly favorable to the mycelial development of the pathogens. This may account for certain apparent discrepancies between the progress of Sclerotinia infection in the experiments and natural infection as observed under New Jersey field conditions.

Sclerotinia sclerotiorum has been widely recognized as a pathogen with a tremendous suscept range, but the virulence shown by S. minor in these tests suggests that under favorable environmental conditions it might become a greater threat than S. sclerotiorum. However, the impression one gets from the literature is that only the lettuce crop is severely damaged by S. minor. It is also significant that under field conditions in New Jersey, S. minor causes severe economic losses in lettuce, but it has never been observed on alfalfa or clover, both of which were highly susceptible to it in the greenhouse tests. Possible explanations may be: 1, there is, to our knowledge, no report of natural occurrence of apothecia of S. minor and this failure to produce ascospores in nature may account for a greater localization of attack; and 2, virulence may not be so great under natural conditions as under the ideally maintained test conditions.

Sclerotinia trifoliorum was very pathogenic on alfalfa and red clover in these tests, but it was not specific to forage legumes. It regularly killed lettuce plants, though not so rapidly as did the other two Sclerotinias. The results of these experiments would suggest that if S. trifoliorum became well established on forage legumes in a given field, and lettuce was then planted in that field for the first time, the lettuce could be severely attacked under conditions of temperature and humidity which favor the pathogen.

NEW JERSEY AGRICULTURAL EXPERIMENT STATION, RUTGERS UNIVERSITY, DEPARTMENT OF PLANT PATHOLOGY, NEW BRUNSWICK

FIELD INOCULATION OF RED CLOVER WITH SCLEROTINIA TRIFOLIORUM[1]

J. H. Graham and R. G. Hanson

One of the many factors contributing to loss of red clover stands in the Northeast is Sclerotinia crown rot caused by Sclerotinia trifoliorum. During the period 1948-51 extensive studies were conducted at State College, Pennsylvania, to isolate resistant plants of red clover and to study the inheritance of resistance to S. trifoliorum (4). Studies were conducted in the greenhouse, using dried grain inoculum for artificial inoculation (6) and a greenhouse-bench moist chamber (5) for incubation. Such factors as age of host, moisture, and temperature influenced appreciably results obtained with the dried-grain inoculum method in the greenhouse. Since many plant breeders do not have extensive greenhouse facilities where environmental conditions can be controlled, this method of obtaining strains of red clover resistant to the disease has some limitations. The purpose of this investigation was to explore the possibilities of inducing an epiphytotic in the field by applying grain inoculum at various rates to obtain differential killing. Use of such a technique would make possible the screening of large numbers of plants for resistance to Sclerotinia crown rot.

Review of Literature

As reviewed by Kreitlow (6) several methods of artificial inoculation of plants under controlled conditions have been developed by various workers for the purpose of isolating resistant material. The possibility of artificial inoculation of clover in the field, however, has not been investigated extensively. Wolf and Cromwell (8) obtained good infection of crimson clover in the field in November by placing in the soil pure cultures of S. trifoliorum growing on corn meal. All plants within 4 to 5 inches of the inoculum were completely killed in four weeks. Similar results on alfalfa were reported by Cormack (1) with cultures grown on oat-hull medium. Frandsen (2) placed pots of soil on which sclerotia had been scattered among plots in August. Mycelial infection of plants was observed by the latter part of September. The infection became more severe later in the season particularly in moist areas where the mycelium grew along the soil. Pape (7) reported good field inoculation using fresh grain inoculum. Kreitlow (6) obtained severe killing of Ladino clover in field plots by scattering dried grain inoculum over the plots in November.

Methods

In the present experiment field inoculation was accomplished by scattering ground, dried-grain inoculum over spring-seeded red clover in the fall. The method and cultures used in preparation of inoculum were the same as those described by Kreitlow (6).

Experiments were conducted during fall and winter periods of 1950 to 1953 inclusive to determine the rate of application of grain inoculum necessary to obtain the desired amount of killing in the field. Areas seeded to Pennscott red clover in the spring were divided into 5 x 5 foot plots. The dried grain inoculum was applied at the rate of 0.2, 0.4, 1.0, 2.0, 3.0, 4.0, and 6.0 grams per square foot; two check plots were included in each of eight replications. The following spring the surviving plants were counted. Data presented are expressed as percentage survival compared with the checks for each replication which were evaluated as 100 percent. In the 1952-53 trial, counts were made in the fall and percentage survival was determined for each plot. The results obtained were similar to those presented and are not included.

Results

Severity of disease increased with the quantity of grain inoculum applied (Table 1). Differences in stand counts obtained among treatments were statistically highly significant. The percentage survival of plants was much lower in the 1951-52 and 1952-53 tests than in 1950-51.

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[1]Contribution No. 127 of the United States Regional Pasture Research Laboratory, State College, Pennsylvania, and Paper No. 1817 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

Table 1. Percentage survival of Pennscott red clover inoculated in the field with different amounts of dried-grain inoculum of Sclerotinia trifoliorum.

Rate[a]	Years		
	1950-51	1951-52	1952-53
0.2	86.0	39.0	54.6
0.4	84.4	33.8	34.2
1.0	62.8	15.7	15.3
2.0	64.1	7.9	6.5
3.0	42.8	4.0	3.5
4.0	55.1	3.0	2.3
6.0	37.4	4.3	2.1
$\bar{x}$	61.80	15.4	16.93
F	13.74*	20.58*	18.48*
L.S.D. (05)	15.0	9.4	13.4
L.S.D. (01)	20.5	12.7	17.9
C.V.	16.32%	61.01%	78.35%
Date inoculated	12/8/50	11/9/51	11/24/52

[a] Rate of grain inoculum applied in grams per square foot.

* Significant for "p" at less than 1% level.

Discussion

The marked difference in severity of infection obtained with different rates of inoculum is difficult to explain. Since the disease is known to be very destructive and red clover is one of the more susceptible hosts, the mere presence of the organism should result in severe infection of plants in all plots. The most logical explanation is that when environmental conditions were unfavorable for the organism the mycelium did not grow far from its source. A heavier application of inoculum would then be necessary for the mycelium to reach a greater number of plants.

One factor associated with environment is time of application. Some observations were made on this factor. In an earlier field test inoculated November 19, 1950, at the rate of two grams per square foot, 15.8 percent of the plants of Pennscott red clover survived (4). Conversely, in the plots inoculated three weeks later, on December 8 (Table 1), there were 64.1 percent survivors of the same strain inoculated with the same amount of inoculum. Differences in temperature following inoculation may account for some of the variation. The average maximum and minimum air temperatures, 3 inches above the ground in nearby orchardgrass-Ladino clover plots, for the three weeks following inoculation on November 19 were 40° and 27° F. and for the same period following inoculations on December 8 were 33° and 25°. During the first period 44 hours were above 45° and 120 hours above 35° while after the second inoculation temperatures remained below 42° and exceeded 35° for only 10 hours[2]. Differences in moisture and snow cover between the two periods were slight. The November temperatures following inoculations in 1951 and 1952 were similar to those in November 1950; however, the fall to spring periods of the last two seasons were milder than the same period during 1950-51. These data indicate that a short period of moderate temperatures after inoculation favors the early establishment of the fungus.

[2]Microclimate data collected by V. G. Sprague, U. S. Pasture Laboratory.

Since resistance of red clover to S. trifoliorum is heritable (3) (4), this field inoculation technique may be valuable in initiating a breeding program. Starting with an adapted variety a large number of plants could be inoculated over a period of years and the survivors selected for breeding material. From a practical viewpoint these survivors would also have been subjected to other factors which may be associated with persistence, e.g., winter killing, or insects.

The field inoculation technique is being used at the U. S. Pasture Laboratory in the Ladino clover breeding program.

Summary

Successful artificial field inoculations of red clover with Sclerotinia trifoliorum were obtained during a period of three years by scattering dried-grain inoculum over the plants in the fall. The rates at which the inoculum should be applied will depend principally upon environment. Observations from the three year's trials indicate that field inoculations should be made at the rate of 1 to 12 grams per square foot in November in areas which have climatic conditions similar to those at State College, Pennsylvania.

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U. S. REGIONAL PASTURE RESEARCH LABORATORY, STATE COLLEGE, PENNSYLVANIA

DISEASES OF BIG TREFOIL IN GEORGIA

Homer D. Wells[1]

During 1952 and 1953, systematic observations have been made on diseases of big trefoil, Lotus uliginosus Schkuhr., in pastures at the Alapaha Range Station, Alapaha, Georgia, and in small plots at the Georgia Coastal Plain Experiment Station, Tifton, Georgia. Diseases observed on big trefoil were: summer blight caused by Rhizoctonia solani Kuehn, blackpatch caused by the blackpatch fungus, anthracnose caused by Colletotrichum truncatum (Schw.) Andrus & W. D. Moore, and southern blight caused by Sclerotium rolfsii Sacc. The first three diseases have been reported on big trefoil, but, so far as the writer can determine, southern blight has not previously been reported as a disease of big trefoil.

The four diseases produce gross symptoms which are very similar but they can be distinguished readily upon close examination in the field. Sometimes only a few stems are attacked during early infection. In late summer all plants in a circular area several feet in diameter may be killed.

Rhizoctonia solani (causal agent of summer blight) produces a rapid aerial blighting of leaves and stems during hot, humid weather from May through September. The leaves appear most susceptible and are frequently killed far in advance of noticeable stem injury. Blighted leaflets turn Quaker gray and are often plastered to the stems by the spiderweb-like aerial mycelium which can usually be seen without the aid of a hand-lens. The infected leaves and stems slowly darken to beech tan, and large, circular areas of dead plants darken to chocolate brown or chaetura black as a result of secondary organisms invading the killed tissue.

The blackpatch fungus (causal organism of the blackpatch disease) causes an aerial blighting of leaves and stems during warm weather from April through October. The leaves and stems appear about equally susceptible, with both showing symptoms as the fungus mycelium develops. Blighted leaflets and stems turn rapidly to dusty green and darken to chocolate brown. The characteristic dark brown to black aerial mycelium of the blackpatch fungus can nearly always be seen without the aid of a hand-lens.

Colletotrichum truncatum (causal organism of big trefoil anthracnose), which causes leaf spot and leaf and stem blight, was first recognized as a part of the big trefoil blight complex here at Tifton in July of 1953. Extent of damage at that time, however, indicated that the disease had been active for a considerable period. Leaf and stem lesions appear as small water-soaked areas less than 1 mm in diameter. During dry periods leaf lesions turn cinnamon brown and slowly involve the entire leaflet. During moist periods, the leaflets are killed rapidly and turn chaetura black because of the numerous acervuli produced over the entire leaflet. During dry periods the stem lesions slowly girdle the stem, turn cinnamon brown, then bleach to Indian tan. During moist periods the stem lesions turn rapidly from cinnamon brown to chaetura black. The characteristic dark colored acervuli and setae can be observed readily in the field with the aid of a hand-lens. Microscopic examination of fruiting bodies from field material and from isolates on poured PDA plates show typical setae and truncate Colletotrichum spores which are in agreement with the description for Colletotrichum truncatum.

Sclerotium rolfsii (causal organism of southern blight) was first recognized as part of the big trefoil blight complex at Tifton, Georgia in July, 1953. This fungus attacks leaves and stems where free moisture is present during hot humid weather. The lower leaves and stems turn water green shortly after infection, then turn cinnamon brown to coffee color within a very short period of time. The tops wilt, fall over and are soon completely overrun by the fungus. Disease development stops completely during dry periods only to become active again after the next rain. This disease can be recognized in the field by the presence of the typical white cottony growth of mycelium along the advancing margin of the blighted area and by the presence of characteristic small brown sclerotia immediately behind the margin of the blighted area. Isolations from sclerotia as well as from tissue from margins of stem lesions on poured PDA plates result in typical cultures of Sclerotium rolfsii.

COOPERATIVE INVESTIGATIONS AT TIFTON, GEORGIA, OF THE DIVISION OF FORAGE CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, AGRICULTURAL RESEARCH ADMINISTRATION, U. S. DEPARTMENT OF AGRICULTURE, THE GEORGIA COASTAL PLAIN EXPERIMENT STATION, AND THE GEORGIA EXPERIMENT STATION.

[1]Agent Pathologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Tifton, Georgia.

FOOT AND ROOT INFECTION BY SAFFLOWER RUST IN MANITOBA[1]

W. E. Sackston[2]

Safflower plants in a nursery at Altona, Manitoba, in which safflowers were grown in 1952, began to wilt, turn yellow, and die, about the middle of June, 1953. Seed for the plots, supplied from the University of Nebraska, was not treated with a fungicide. These symptoms were not observed in a similar test at Winnipeg, on land where safflowers had not been grown previously. Seed for the Winnipeg test was treated with both Ceresan and Parzate. When the disease was brought to the writer's attention by I. Toews, Assistant Agronomist, Cooperative Vegetable Oils, Ltd., Altona, in mid-July, most of the diseased plants were dead and dry, although some were just starting to wilt. Affected plants could be pulled out of the soil easily. They were girdled about 1/2 to 1 inch below the soil line. The underground stem and root above the girdle were discolored, rough, and in some cases considerably enlarged (Fig. 1). Apparently most of the plants were affected at about the same time, but some survived the original injury and did not collapse until later. Some plants without any above-ground symptoms were found to be constricted below the soil line, although girdling was not complete.

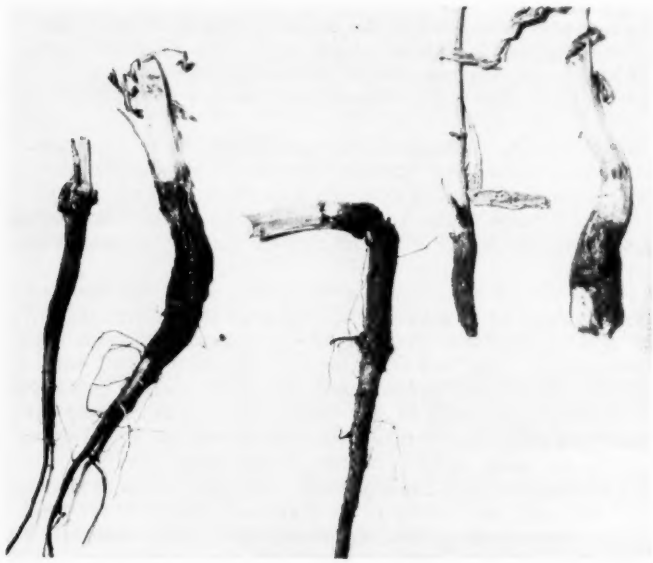

FIGURE 1. Safflower roots showing injury induced by Puccinia carthami.

Striking differences in varietal reaction to the disease were observed. Estimates were made of the percentage of plants surviving in each of the plots on July 16. Averages of the four replicates of each variety are given in Table 1.

Rust infection on the leaves of surviving plants varied from trace to moderate. N-520 and N-803-13-2 have not been grown previously at Winnipeg. Seedlings of the other five varieties were found to be susceptible to rust in greenhouse inoculation tests in the spring of 1953. There was no apparent correlation between the reaction of the varieties to infection at Altona and their reaction to Pythium root rot in irrigated plots at Lethbridge, Canada (1) or to Phytophthora root rot in greenhouse inoculation tests and in the field in California (3).

The symptoms observed at Altona correspond with those attributed by Shuster and Christiansen (2) to foot and root infection by Puccinia carthami Cda. in Nebraska, in fields where safflower was grown for two successive years. They demonstrated experimentally that the underground infection could be produced by growing safflowers from infested seed or in soil infested with rust teliospores.

[1]Contribution No. 1310 from the Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa, Canada.

[2]Plant Pathologist, Plant Pathology Laboratory, Winnipeg, Manitoba.

Table 1. Average percentage survival of safflower varieties in plots at Altona in 1953.

Variety	Percentage survival
N-8	1
N-10	1
N-852	1
Indian	5
N-6	8 (1% in 3 replicates, 30% in 1 replicate)
N-520	45
N-803-13-2	55

Rust sori were found on the underground stems and roots of some plants in the plots at Altona. When diseased plants were examined in the laboratory at Winnipeg, numerous urediospores and some teliospores were found in scrapings from the girdled portions and adjacent areas of the roots. Diseased roots plated on agar gave rise to colonies of Alternaria sp., Fusarium spp., some miscellaneous fungi, and miscellaneous bacteria. This is the first occurrence recorded in Canada of a foot and root disease of safflower apparently attributable to infection by seed- or soil-borne Puccinia carthami.

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PLANT PATHOLOGY LABORATORY, WINNIPEG, MANITOBA, CANADA

A BACTERIAL PARASITE OF TAMARISK

J. G. Brown[1] and Thomas G. Scandone[2]

A bacterium that kills potted tamarisks in the greenhouse has been repeatedly isolated in pure culture by us from infected tamarisks in Arizona, New Mexico, and Texas. The microorganism is interesting for several reasons. It is the first bacterial parasite to be reported for tamarisks so far as we can determine by reference to available literature; it is remarkably resistant to heat for it was not completely killed in suspension in a liquid medium, in the usual TDP tubes, at a temperature of 98.5° C. for 10 minutes, although its subsequent growth was retarded; its growth on solid media develops streptococcus-like colonies, but the individual cells are straight rods that may become motile when free. Artificial inoculation of the bacterium into tamarisks (Fig. 2) kills leaves, twigs, and entire rooted cuttings from which it has been re-isolated in pure culture (Fig. 3); it also evidently kills tamarisk plants in the field.

FIGURE 1. Dying tamarisks, so-called salt-cedars, in the foreground and larger dead ones in the background.

The parasitic bacterium of the tamarisk appears to attack the parenchyma of the host. It seldom causes even inconspicuous lesions before the more superficial layers of cells of the attacked parts collapse, apparently from excessive water-loss. Soon the affected mass of foliage turns brown and may hang in formless bunches on the host plant. The occurrence of dying and dead salt-cedars (Fig. 1) in all tamarisk areas visited by the authors, with subsequent isolation of the bacterium from such plants, leads us to believe that the parasite is the cause of the observed sickness and mortality.

The known host of the isolated and tested bacterium, Tamarix pentandra, otherwise known as the salt-cedar, is a most obnoxious weed. It was introduced into Arizona some time prior to 1901. Following wet seasons, the plant has spread until it reportedly almost monopolizes a total area of hundreds of square miles along rivers and washes in this State, New Mexico, and Texas. The most objectionable characteristic of the salt-cedar is its efficiency as a pump: in dense growths it transpires so vigorously that little water in the form of showers actually reaches

[1]Plant Pathologist.
[2]Graduate Student.

FIGURE 2. **Salt-cedar plant** 266 killed as the result of spraying with a suspension of a bacterium isolated from dying and dead tamarisks in the field. Salt-cedar 273, sprayed at the same time with sterile distilled water, remains healthy.

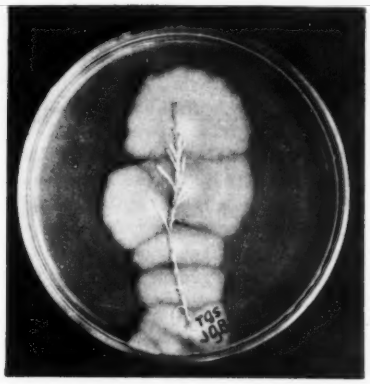

FIGURE 3. Re-isolation of bacterial parasite in pure culture, from dead twig of salt-cedar killed by spraying with a pure culture of the same bacterium.

the subterranean reservoir. Destruction of the weed through the use of chemicals, mechanical removal with bulldozers, etc., is expensive, hence the search for natural enemies of the troublesome plant.

The bacterial parasite of tamarisk herein briefly described will be technically treated in a future paper, together with further studies of its relation to the host. The studies are progressing under a cooperative agreement between the U. S. Reclamation Service and the Arizona Agricultural Experiment Station.

DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF ARIZONA AND ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON

GRAFTING FAILURE OF ORNAMENTALS INDUCED BY THIELAVIOPSIS BASICOLA

Kenneth F. Baker, Lily H. Davis,
and H. Earl Thomas

Thielaviopsis basicola (Berk. & Br.) Ferraris is an omnivorus and ubiquitous parasite in coastal California, commonly causing root and stem decay. It generally occurs under conditions unfavorable to growth of the host (e.g., cold wet soil, fertilizer injury to the roots, severe virus injury of the host, excessive soluble salts) or with a non-growing or dormant state of the host (e.g., transplanted poinsettia stock plants). This is comparable to the situation reported[1] for the related Chalaropsis thielavioides Peyr. on its hosts.

Instances have been noted during the past several years in which Thielaviopsis was associated with grafting failure of three ornamental hosts. The stems affected were in a state of at least partial dormancy.

In March, 1945 propagation stock of tree peony (Paeonia suffruticosa Andr.) had a high percentage of graft failures in a nursery in Alameda County. This plant, commonly grown instead of the herbaceous type in California because of its lower winter chilling requirement, is grafted on roots of the wild P. suffruticosa, or on P. albiflora Pallas or P. officinalis L. during fall or winter. The grafted plants are placed in benches of sand, and the unions kept moist by their proximity to the surface of the medium. The cut surfaces of both stock and scion had a black fungus crust similar to that reported[2] for rose grafts infected with Chalaropsis. This crust consisted of chlamydospores of T. basicola, and the fungus was readily isolated in pure culture. There were other fungi present on some of the surfaces, as there have also been[2] with Chalaropsis.

In May, 1946 several peony grafts were made in which the cut surfaces of stock and scion were atomized with a suspension of endoconidia and chlamydospores of the T. basicola isolate. No unions of the graft resulted, and after three weeks the fungus had developed a black layer over the cut surfaces. The checks united satisfactorily and were free of the fungus. Pieces of both woody and succulent peony stems inoculated as above and held in moist chambers also developed discoloration and decay due to Thielaviopsis.

In September, 1949 plants of Camellia japonica L. in a Los Angeles nursery exhibited the above type of graft failure. Thielaviopsis basicola was abundantly present on the cut surfaces.

In October, 1952 plants of Lonicera sp. in a nursery in Los Angeles County had graft failure, in which T. basicola was again conspicuous.

It is concluded that T. basicola is able to cause graft failures by growing over the cut surfaces, killing enough of the tissues to prevent union. The fungus is known to cause stem rot of numerous plants, and the infections described here were, in effect, a specialized type of such injury. Grafting failure caused by T. basicola appears, however, not to have been previously reported.

DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF CALIFORNIA, LOS ANGELES 24 AND BERKELEY 4.

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NEW OR UNUSUAL RECORDS AND OTHER BRIEF NOTES ON PLANT DISEASES

OAK WILT FUNGUS PATHOGENIC ON QUERCUS CHRYSOLEPIS AND QUERCUS AGRIFOLIA

By Paul F. Hoffman

Several evergreen oaks have been used in our greenhouse studies of oak wilt at time when native species of oak were dormant or unavailable. Quercus agrifolia Née and Q. chrysolepis Liebm.[1] have been used as suscepts in chemotherapy and tracer studies with satisfactory results. Q. chrysolepis and Q. agrifolia are new hosts for Endoconidiophora fagacearum Bretz, the oak wilt fungus. Incubation periods of 20 to 28 days were required when inoculations were made by injection of conidia with a hypodermic syringe at the base of the new growth. The incubation periods are nearly identical with those required by native red oak species under greenhouse conditions.

SECTION OF APPLIED BOTANY AND PLANT PATHOLOGY, ILLINOIS STATE NATURAL HISTORY SURVEY, URBANA, ILLINOIS

[1]We wish to thank Mr. P. C. Everett, Superintendent of the Rancho Santa Ana Botanic Garden, Claremont, California, for supplying us with acorns of Q. agrifolia and Q. chrysolepis.

ADDITIONAL HOSTS OF TOMATO BUCKEYE ROT FUNGUS IN TENNESSEE

By E. L. Felix

Three additional suscepts of the tomato buckeye rot organism, Phytophthora parasitica Dast. (P. terrestris Sherb.), have been found near Knoxville, as determined by cultural and cross inoculation studies.

Strawberry (Fragaria chiloensis var. ananassa) -- The buckeye rot fungus was found causing rot of several late appearing berries of the Aberdeen variety on July 19. Abundant aerial mycelium and mature sporangia were present. Symptoms consisted of a semi-firm brown rot. Subsequent examination, after softening momentarily, of dried rotten berries, collected the latter part of May during the normal bearing season, also revealed the presence of similar Phytophthora sporangia, presumably of the same fungus, in other unrecorded varieties. All efforts to find the Phytophthora on other parts of the strawberry plant have thus far been negative.

Lily (Lilium regale) -- This disease of regal lily was observed early in July among a few recently planted small bulbs. It appeared as a top rot, causing collapse. After growth of a second top and repeated rot, the bulbs finally rotted completely, perhaps due primarily to the same fungus.

Cockscomb (Celosia argentea var. cristata) -- Damping-off of a cockscomb plant about one foot in height was found to be due to the buckeye rot fungus.

TENNESSEE AGRICULTURAL EXPERIMENT STATION, KNOXVILLE

INCIDENCE OF SOME TOMATO DISEASES IN TENNESSEE THIS SEASON

By E. L. Felix

Seedling stem rot -- A brown rot of the stems about one inch above the soil line, extending a few inches upward, and due to Pythium aphanidermatum, was observed in the greenhouse.

Late blight (Phytophthora infestans) -- As in 1952, no late blight has been observed in Tennessee so far this year on either tomatoes or potatoes. Earlier during the rainy season, temperatures were too high and now for some time it has been both very hot and dry in the State.

Buckeye rot (Phytophthora parasitica) -- Buckeye rot of tomatoes occurred to some extent sporadically during the latter part of June and in July, but dry weather has checked development of the disease on this crop, as well as on rhubarb and other plants.

TENNESSEE AGRICULTURAL EXPERIMENT STATION, KNOXVILLE

POWDERY MILDEW ON BURLEY TOBACCO IN KENTUCKY

By R. A. Chapman

A powdery mildew, Oidium sp., was observed on the leaves of burley tobacco plants growing in a greenhouse at Lexington, Kentucky. Small yellowish spots were first observed on the older leaves of ten-weeks old plants in early March 1953. Chains of conidia could readily be found in the spots, although conidial development was not abundant. The disease did not spread over the plants as they grew and was not observed on older plants. A succession of plants set in this place in the greenhouse until the end of June became infected when they were approximately two months of age.

The inoculum apparently was provided by a nearby hybrid, Nicotiana bonariensis x N. alata, that was thoroughly covered by powdery mildew. No cleistothecia were observed on the hybrid or burley plants.

KENTUCKY AGRICULTURAL EXPERIMENT STATION, LEXINGTON

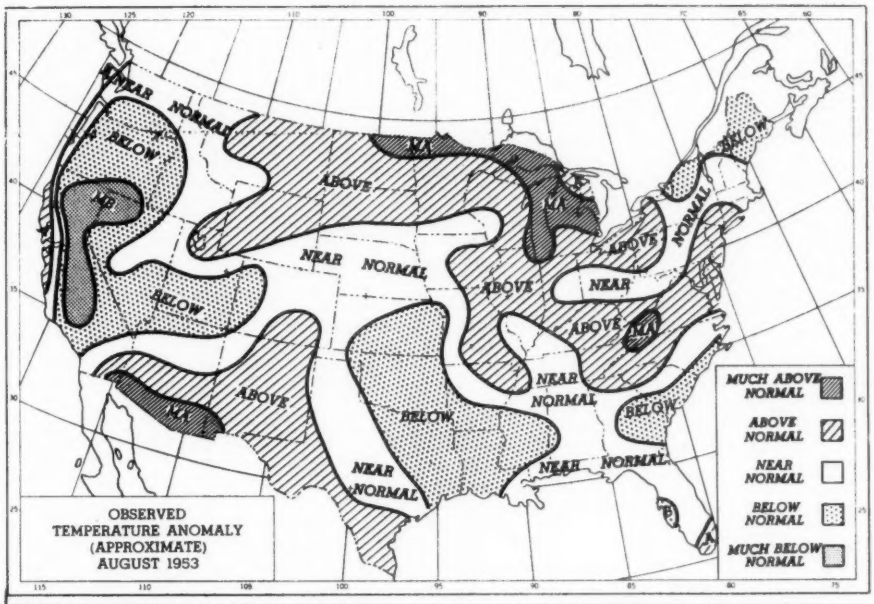
PEANUT RUST IN GEORGIA

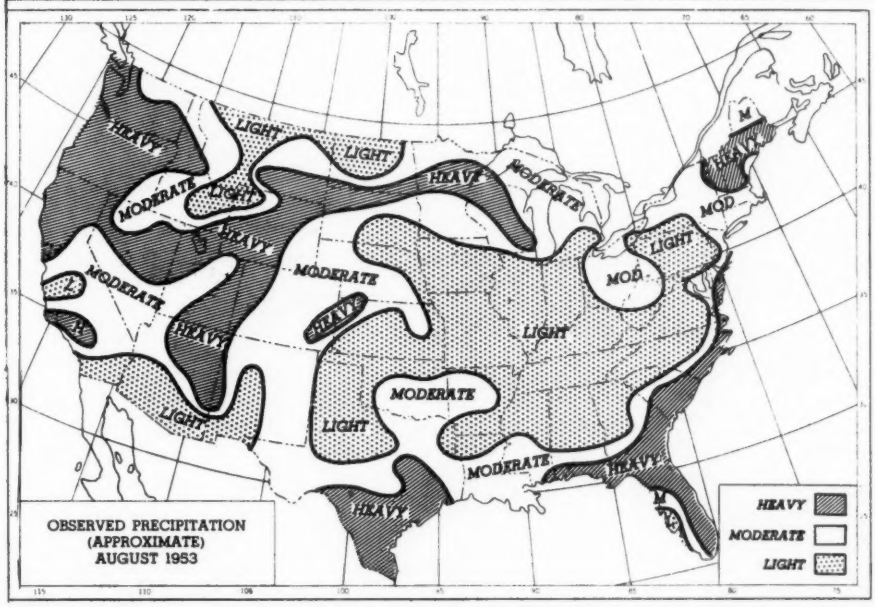
By Harvey W. Rankin

On September 1, Mr. J. L. Stephens, Agronomist at this Station, brought some diseased peanut plants. Examination showed the presence of rust, probably Puccinia arachidis Speg. Inspection of the field showed the area of infection small but the injury serious within the area. Infection occurred on both leaves and stems, causing defoliation and also death of the stems. The next day a telephone call from Irwin County reported trouble there. Samples sent in for examination showed this to be rust also. In this case the damage was much more extensive and just as serious.

It is not believed that there is much danger of rust becoming a serious disease in Georgia. Weather conditions this summer have been favorable for its development and spread, and it is possible that it may be several years before we see this trouble again.

GEORGIA COASTAL PLAIN EXPERIMENT STATION, TIFTON





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.